Nursing Children and Young People

Practice Question, debunking myths: How much air in an IV line is too much?

--Manuscript Draft--

Manuscript Number:	NCYP1329R1
Article Type:	Article - if in doubt use this one
Full Title:	Practice Question, debunking myths: How much air in an IV line is too much?
Corresponding Author:	Leah Rosengarten Northumbria University Newcastle Upon Tyne, UNITED KINGDOM
Abstract:	As nurses, we're always vigilant to remove air bubbles from patients' IV lines, yet we've probably also all heard that 'a little air won't cause harm'; but is this true, or a myth? How much air in an IV line is OK, and how much could potentially cause harm? This 'Practice Question' article will debunk the myth and help you practise with confidence.
Keywords:	Clinical issues; Intravenous Infusions; Air Embolism
Additional Information:	
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What is the word count of your document excluding both references and the abstract?	561
Author Comments:	This is part of the Practice Question series commissioned by RCN Nursing Children and Young People with Leah Rosengarten.

Practice Question, debunking myths: How much air in an IV line is too much?

As nurses, we're always vigilant to remove air bubbles from patients' IV lines, yet we've probably also all heard that 'a little air won't cause harm'; but is this true, or a myth? How much air in an IV line is OK, and how much could potentially cause harm? This 'Practice Question' article will debunk the myth and help you practise with confidence.

For obvious reasons, this question is not one that can be easily answered. To say that it would be unethical to inject air into people and see how much was required to cause harm, would be an understatement. Initial studies that sought to answer how much air was unsafe, used animal participants which still raises ethical concerns, and these studies often produced widely varying results (Adornato et al, 1978; Ohkuda et al, 1981).

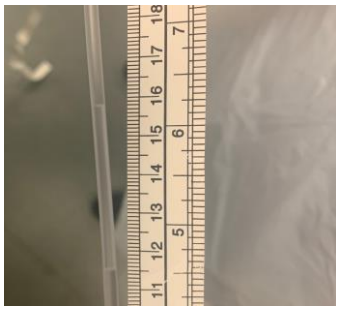
A venous air embolism occurs when air enters a venous structure and moves through the heart to the pulmonary circulation (Gordy and Rowell, 2013). The increase in pressure in the circulatory system from an air embolism can cause pulmonary hypertension and death (McCarthy et al, 2016).

It is recognised that air embolisms due to IV infusions or cannulation are rare, though it does still occur (Vinan-Vega et al, 2019), and there are cases in paediatrics where air embolisms from IV cannulas have proved fatal (Wald et al, 2003; Agarwal, et al, 2009; Watkins, McCarver and Van Bebber, 2012). A study which sought to identify how frequently the insertion of IV cannulas was associated with air embolisms discovered that a small air embolism was visible in 4.8% patients, though these air embolisms were not identified to be harmful (Groell, Schaffler and Rienmueller, 1997).

So, how much is ok?

It seems no one is sure. Tiny volumes of air, under 200µl (0.2ml, Figure 1), have been proven not to be hazardous (Blomley et al, 2001), whilst IV administration of between 300-500 mL air at a speed of 100 mL/min is considered to be fatal in adults (Yesilaras, Aksay, and Kilic, 2014). Ho (1999) suggests that between 0.5-1ml of air in the pulmonary vein of an adult can cause cardiac arrest, which leaves uncertainty about the impact a smaller bubble could have in a neonate. The size of the air bubble which constitutes a risk is proportionate to the diameter of the vessel it occludes, therefore the smaller the child, the smaller the bubble that could cause harm.

Figure 1. Approx. 0.2ml air in a standard IV line



What should we do?

As children's nurses then, what can we say with confidence? The ideal management of IV lines is to remove all air from the IV giving set and NICE guidance (2013) states that staff must be competent in the preparation and administration of IV fluids. The use of IV infusion pumps to recognise air bubbles and filters to remove air from lines can be useful but does not negate the need for nursing recognition and action.

We should be alert, as well, to the signs and symptoms of a possible air embolism if air were to get into an IV line; anxiety, shortness of breath and/or increased respiratory rate, chest pain, cyanosis, tachycardia, headache, confusion, agitation, fainting, slurred speech, blurred vision, seizures or ataxia (Yesilaras, Aksay, and Kilic, 2014; Vinan-Vega et el, 2019).

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Changes made to air in line article

1) Removed words from introduction to ease word count
2) Included recognition of ethical considerations of animal studies
3) Reordered paragraph to make clearer
4) Adjusted volume section to identify the lack small amounts can cause harm and that the smaller the child, the greater the risk of harm from a small bubble.
5) Conclusion changed to identify that no amount of air should be the goal.

Response to reviewers.

Thank you for taking the time to review my article. I appreciate your comments on the lack of a clear introduction, main body and conclusion and have tried to include this as much as possible whilst sticking to the constraints of a 550 word limit.

It is recognised that several of the references are older than ideally used, but despite diligent searching, there is no further recent, reputable literature on this subject due to the difficulties around measuring the impact of this. Much of what is available is case study literature.

Thank you for your comments on the value of filters, I have included a sentence to recognise this. My experience in clinical practice is that filters are not routinely used in all IV lines and there are no guidelines to support this, so I have not made this recommendation.

Photograph or air in line

Click here to access/download;Photograph;air in line picture.jpg